Chapter 4
Energy Infrastructure

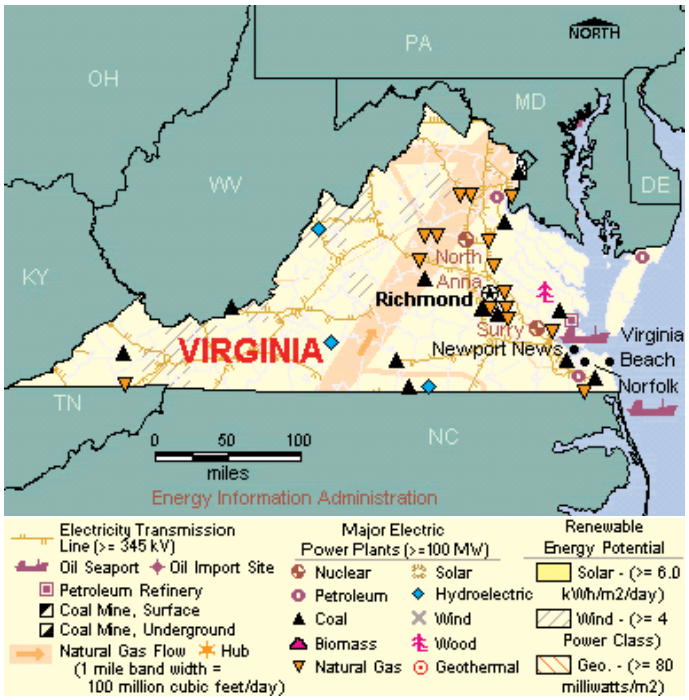
4.0 Energy Infrastructure

A robust infrastructure is needed to deliver affordable, reliable energy supplies. Virginia's energy infrastructure (see Figure 4-1) includes facilities required for:

- Electricity generation, transmission, and distribution.
- Natural gas supply, transmission, and storage.
- Petroleum production, refining, transportation, and distribution.
- Coal mining, transportation, and export.
- Propane supply, transportation, and distribution.
- Wood/biomass supply and transportation.

The electric infrastructure is the most widespread energy system in the state.

Figure 4-1 Virginia's Energy Infrastructure



Emerging infrastructure issues and opportunities include the need for new electrical transmission and generation, natural gas pipeline improvements, utility-scale wind siting, alternative fuels production, and uranium mining.

The electric infrastructure is the most widespread energy system in the state. PJM, the power pool of which Virginia is a member, reports that the electric supply infrastructure in northern Virginia will need to be expanded by 2011. Studies also show the need for additional electric-system capacity to serve the Tidewater region. Conservation and demand-control actions may delay the need for expansion, but they will not eliminate it. This Plan includes the goal to meet the need for electric generating capacity by adding over 2,300 megawatts of capacity.

Virginia's natural gas infrastructure supports a wide array of users. Although the infrastructure has been adequate, there have been constraints in south Hampton Roads, where several options have been proposed to increase infrastructure capacity. This includes construction of a third pipeline crossing the James River between north and south Hampton Roads and construction of new local distribution pipelines and peak storage facilities.

Virginia receives gasoline, diesel fuel, fuel

oils, and aviation fuel from two petroleum-product pipelines originating in the Gulf of Mexico region, the oil refinery in Yorktown, and ship and barge deliveries to terminals on Virginia's coast. Virginia's alternative fuel production is currently limited to several small (generally 5 million gallons per year or less) biodiesel facilities.

Developers of large-capacity biofuel plants (100-million-gallon and greater range) have shown considerable interest in locating in Virginia because of the state's proximity to end-use fuel markets and feedstock potential (barley, switchgrass, agricultural waste, solid waste, and algae). Virginia is expected to have several such plants come on-line in the next five years. Advancing technologies for cellulosic, waste-to-fuel, and algae-based processes could set the stage for significant long-term growth of the alternatives fuels production industry in Virginia.

This Plan includes goals to increase the capacity of the petroleum refinery in Yorktown by 40,000 barrels per day (approximately a 45 percent increase) and to provide 300 million gallons per year of ethanol production and 120 million gallons per year of biofuels production. These increases would offset gasoline and diesel fuel imports needed to fuel 1.2 million of the state's cars and trucks per year.

Virginia relies on rail and highway infrastructure to transport coal. A congested and constrained rail system represents the biggest challenge, but road infrastructures for coal are generally adequate.

Siting of utility-scale wind turbines in Virginia has been a topic of much public debate, with a proposed land-based wind farm in Highland County having received the most attention. While the benefits of renewable energy are clear, there are environmental and community-related challenges. If environmental concerns can be overcome, the debate comes down to community acceptance. Virginia's biggest opportunity in this area lies in offshore wind (see Chapter 2).

Virginia's energy industries need a supply of trained workers to construct and maintain the state's energy infrastructure and provided needed energy supplies. Many energy industries need workers with specialized skills in areas such as power plant operations, mining, and propane delivery. Many energy industry workers also will be retiring during the ten-year term of this Plan.

The Virginia Community College System, working with area economic development organizations and businesses, can play a vital role in providing training to energy business workers. This may take the form of basic technical and work skills training and specialized training related to a particular energy industry. Examples include coal-miner training provided by Southwest Virginia and Mountain Empire Community Colleges and nuclear-industry training provided through the Center for Advanced Engineering and Research in Lynchburg. Colleges and universities also must train the next generation of engineers and scientists needed by the state's energy businesses. Efforts to develop vocational-training curricula should account for regional needs of energy providers. An example of such a program is the Kentucky Coal Academy's curriculum provided to coalfield high schools in Kentucky.

A significant challenge that faces the entire energy industry is preparedness and risk management. Virginia's energy industry must take steps to protect the state's energy infrastructure from natural and human-made disasters. This includes performing ongoing maintenance of facilities and rights-of-way, updating controls and infrastructure to replace aging equipment and facilities, and where needed, hardening existing facilities for protection. The industry must also make improvements to ensure the safety of the energy infrastructure. Particular emphasis should be placed on central facilities such as power plants, bulk fuel storage facilities, and transmission infrastructure. Virginia and federal public safety and homeland security agencies should maintain clear communication with energy providers to develop, test, and

coordinate response plans to any risks or incidents.

State and local governments must also be diligent in preparing for energy emergencies. Emergency response requires a robust and uninterruptible energy supply. Installing generators at critical facilities designated for response or shelter is an important step in improving readiness and response. At a minimum, critical facilities should be retrofitted to facilitate hook-up of generators in a disaster. Historical evidence shows that many localities have contracts with fuel vendors that do not have the infrastructure or equipment to maintain supplies during times of disaster. State agencies and local governments should have both primary and back-up fuel contracts that will ensure fuel delivery during a disaster.

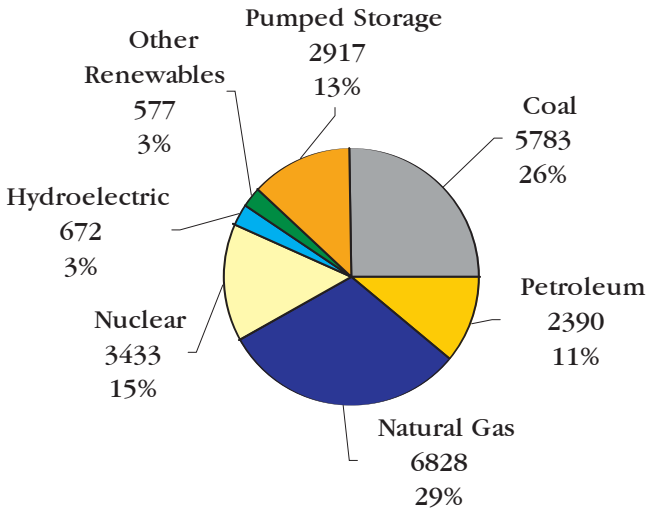
4.1 Electrical Generation, Transmission, and Distribution

4.1.1 Existing Generating Infrastructure

An understanding of how electric demand will grow is essential for resource planning. Virginia's investor-owned electric utilities will be required to file, coincident with their biennial rate filings before the State Corporation Commission, plans for projected generation and transmission requirements to serve their native load for the next ten years. These plans must show how the utilities will provide for and pay for the needed resources.

Virginia electric utilities operate electrical generating facilities throughout the state. Their total summer net generation capacity in 2005 was 22,599 megawatts, sixteenth highest among the fifty states.[56] (Texas ranked first, with 101,046 megawatts.) A large portion of Virginia's electric energy generation capacity comes from coal-fired and nuclear plants (26 and 15 percent, respectively). The electric utilities also operate several oil-fired, gas-fired, and hydroelectric generation facilities to supplement power from coal, nuclear units, and interstate power transfers when needed. Figure 4-2 shows Virginia's electric generating capability (in megawatts) by fuel type for the year 2005.[57] Table 4-1 lists the state's ten largest electric generating plants in 2005.[58] The largest one is a pumped storage plant in Bath County.

Figure 4-2 Virginia Electric Generating Capability (MW) by Fuel Type, 2005



[56]U.S. Department of Energy, Energy Information Administration (EIA), Individual State Electricity Profiles (www.eia.doe.gov/cneaf/electricity/st_profiles/e_profiles_sum.html).
[57]EIA, State Electricity Profiles-Virginia, Table 4: Electric Power Industry Capability by Primary Energy Source, 1990 through 2005 (www.eia.doe.gov/cneaf/electricity/st_profiles/sept04va.xls).
[58]EIA, State Electricity Profiles-Virginia, Table 2: Ten Largest Plants by Generating Capability, 2004 (www.eia.doe.gov/cneaf/electricity/st_profiles/sept02va.xls).

Table 4-1 Ten Largest Plants in Virginia by Generating Capability, 2005

Plant	Energy Sources	Operating Company	Net Summer Capability (MW)
1. Bath County	Pumped Storage	Dominion Virginia Power	2,679
2. North Anna	Nuclear	Dominion Virginia Power	1,835
3. Possum Point	Gas	Dominion Virginia Power	1,706
4. Chesterfield	Coal	Dominion Virginia Power	1,631
5. Surry	Nuclear	Dominion Virginia Power	1,598
6. Yorktown	Coal	Dominion Virginia Power	1,141
7. Tenaska Virginia Generating Station	Gas	Tenaska Virginia Partners LP	910
8. Clover	Coal	Dominion Virginia Power	865
9. Doswell Energy Center	Gas	Doswell Ltd Partnership	820
10. Chesapeake	Coal	Dominion Virginia Power	710

Virginia's demand for electricity varies on both a daily and seasonal basis. The large coal-fired and nuclear generators, as well as some of the hydroelectric plants, serve the base load, while oil and gas-fired electric generation plants generally operate to produce power during periods of high electricity demand.

The state's two major electric utilities provide the largest part of state electric supply from coal-fired power plants. American Electric Power operates the Clinch River plant in Russell County and the Glen Lyn plant on the New River in Giles County, near the West Virginia border. Dominion operates nine coal-fired plants in eastern Virginia, including the Clover plant on the Roanoke River in Halifax County. Owned in partnership with Old Dominion Electric Cooperative, this is among the nation's newest and most modern coal-fired generating plants.

Virginia has two large commercial nuclear power plants, North Anna in Louisa County and Surry in Surry County. Dominion built and operates both plants. North Anna consists of two reactors that came on-line in 1978 and 1980 and are capable of producing a total of 1,842 megawatts of electricity. Surry consists of two reactors that came on-line in 1972 and 1973 and are capable of producing a total of 1,598 megawatts.

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4.1.2 Adequacy of Electric Generation Infrastructure

Virginia imports approximately 29 percent of its electrical requirements and has experienced rapid load growth over the past ten years. According to the trend forecast of 1.85 percent growth per year, demand will increase 6,568 megawatts over the next decade (see Table 4-2).[59,60] Note that the need for new generation capacity may be reduced by successful conservation and efficiency (Chapter 3).

[59]The latest PJM electric summer peak demand forecast for the Dominion load zone shows a similar projected annual growth rate, 1.88% per year for the 2006-2016 time period. See Section 5.0 of the PJM 2007 Regional Transmission Expansion Plan, Figure 5-3.

[60]The electric load forecast for Virginia presented in this table was developed by GDS Associates and is described in more detail in Chapter 2.

Table 4-2 Forecast of Peak Electric Demand in Virginia

Year	Base Case Forecast for Peak Electric Demand in Virginia (MW)	Cumulative Growth in MW Demand From 2005 Base Year	Virginia Capacity Needed to Maintain Current Electricity Imports Ratio of 29.4%
2005	32,026	0	22,599
2006	32,683	657	23,063
2007	33,340	1,314	23,526
2008	33,997	1,971	23,990
2009	34,653	2,627	24,453
2010	35,310	3,284	24,916
2011	35,967	3,941	25,380
2012	36,623	4,597	25,843
2013	37,280	5,254	26,307
2014	37,937	5,911	26,770
2015	38,594	6,568	27,233
2016	39,250	7,224	27,697
Source: GDS Associates, Inc. , June 2007			

Virginia enacted a voluntary renewable portfolio standard in its 2007 electric utility regulation legislation.[63] This calls for Virginia's participating investor-owned electric utilities to generate 4 percent or more of their electricity from renewable sources by 2012, 7 percent or more by 2017, and 12 percent or more by 2022.

Significant demand growth has occurred in northern Virginia, where the population has increased by 66 percent since 1990. Loudoun and Prince William Counties consistently rank among the fastest growing counties in the United States.[61] Virginia consequently faces a growing gap between population growth in certain regions and available electricity to serve those regions. Electric demand in northern Virginia is expected to increase by approximately 2 percent a year, requiring an additional 4,000 megawatts of supply over the next decade.[62] Because of the limited ability to build new central power plants in this region, the most probable solution is a combination of conservation and efficiency, distributed generation, and new transmission.

Some of this capacity could be met with new renewable energy (see Chapter 2). Virginia enacted a voluntary renewable portfolio standard in its 2007 electric utility regulation legislation.[63] This calls for Virginia's participating investor-owned electric utilities to generate 4 percent or more of their electricity from renewable sources by 2012, 7 percent or more by 2017, and 12 percent or more by 2022. Meeting this would require generating more than 7.75 million megawatt-hours of power from renewable sources. Dominion, American Electric Power, and private developers are working on plans to develop new renewable-power generation.

Some of these renewable projects and other distributed generation can be located in built-up areas, closer to electric loads. This can reduce the need for new long-distance electric transmission.

Virginia has established a target of meeting 10 percent of its 2006 electric demands through conservation by 2022. Prorating this target over the next ten years, the state should be able to meet 6 to 7 percent of this goal, or nearly 1,500 megawatts, by 2016.

4.1.3 Planned Electric Generation Facilities

Several electric generation plants are being planned or considered for construction in Virginia (see Table 4-3). The largest is the nuclear reactor at the North Anna power station. Dominion has already requested an early site permit for two new reactors at the site. The Nuclear Regulatory Commission (NRC) held public hearings on the application for the permit

[61]Dominion Power, "Dominion: Meeting Northern Virginia's Growing Demand for Electricity," 2007 (www.dom.com/about/elec-transmission/powerline/meadowbrook/ppt/newline.ppt).
[62]C. Flores, "Dominion Searches for Ways to Meet Demand," Daily Press [Newport News, VA], January 16, 2007.
[63]See chapters 933 and 888 of the 2007 Virginia Acts of Assembly (http://leg1.state.va.us).

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in April 2007. While the NRC had not issued the permit as of June 2007, it has issued its final environmental impact statement, which stated that construction would have minimal adverse effect on land use, air quality, and the local ecology. The NRC is expected to decide whether to issue the early site permit later in 2007.

Dominion has selected a reclaimed surface coal mine in Wise County as a site for a new coal-fired power plant. The Virginia City Hybrid Energy Center is projected to be operational by 2012, with an estimated capacity of 585 megawatts. If constructed, the station will use Virginia coal, coal waste, and biomass in an advanced circulating fluidized bed boiler. The site has adequate local fuel and water supplies, available electrical transmission, and is expected to have minimal environmental impact.[64] Dominion officials say it would bring $3.5 to $4 million in tax revenue per year and would create more than 1,000 construction jobs, 250 mining jobs, and 75 to 100 permanent jobs at the plant. Dominion hopes to start construction in 2008 but still needs several permit approvals.[65]

Competitive Power Ventures of Silver Springs, Maryland, plans to construct a new natural gas-fired electric power plant in Warren County. The firm received a certificate from the State Corporation Commission (SCC) in 2003 and a permit from the Department of Environmental Quality in 2004. Competitive Power Ventures said the plant will pay about $1.9 million per year in property taxes to Warren County and will employ twenty people with an average annual salary of $55,000.[66]

Highland New Wind Development has announced plans to construct twenty-two wind towers west of Monterey. More information on the project is provided below in Section 4.7, Renewable Energy Infrastructure-Wind Power.

Dominion filed an application with the SCC on April 19, 2007, to install two gas-/oil-fired turbine generators at its existing Ladysmith power plant in Caroline County. If approved, the two 150-megawatt peak power units are expected to be in operation by August 2008.

American Electric Power plans to develop two Integrated Gasification Combined Cycle (IGCC) power plants, with a total capacity of about 1,200 megawatts, in West Virginia and Ohio. Some of this power would serve Appalachian Power customers in Virginia.

Table 4-3 Electric Generation Facilities Planned in Virginia

Owner Name	Plant Name	Unit	County in Virginia	Primary Fuel	Nameplate Capacity (MW)	Estimated Commercial Online Date
Feasibility Stage (Planned new generator undergoing feasibility study)						
Hydro Matrix LP	Flannagan Hydroelectric Project	1	Dickenson	Water	5	Not available
Virginia Electric & Power	North Anna	NB3	Louisa	Uranium	917	January 1, 2050
Proposed (New generator planned for installation)						
Ameresco, Inc.	Rappahannock Landfill Project	IC1 2	Stafford	Landfill gas	2.14	December 31, 2007
Fauquier Landfill Gas LLC	Fauquier Landfill	IC3	Fauquier	Landfill gas	1	Not available
Virginia Electric & Power	Virginia City Hybrid Energy Center	ST1	Wise	Coal	500	June 1, 2012
Application Pending (Application filed for permits, regulatory approval pending)						
CPV Warren LLC	CPV Warren Power Generating	CC1	Warren	Natural Gas	520	June 1, 2010
Highland New Wind Development LLC	Highland County Wind	WT1 19	Highland	Wind	38	December 31, 2008
Virginia Electric & Power	Ladysmith Generation Facility		Caroline	Natural Gas/Fuel Oil	300	August 2008

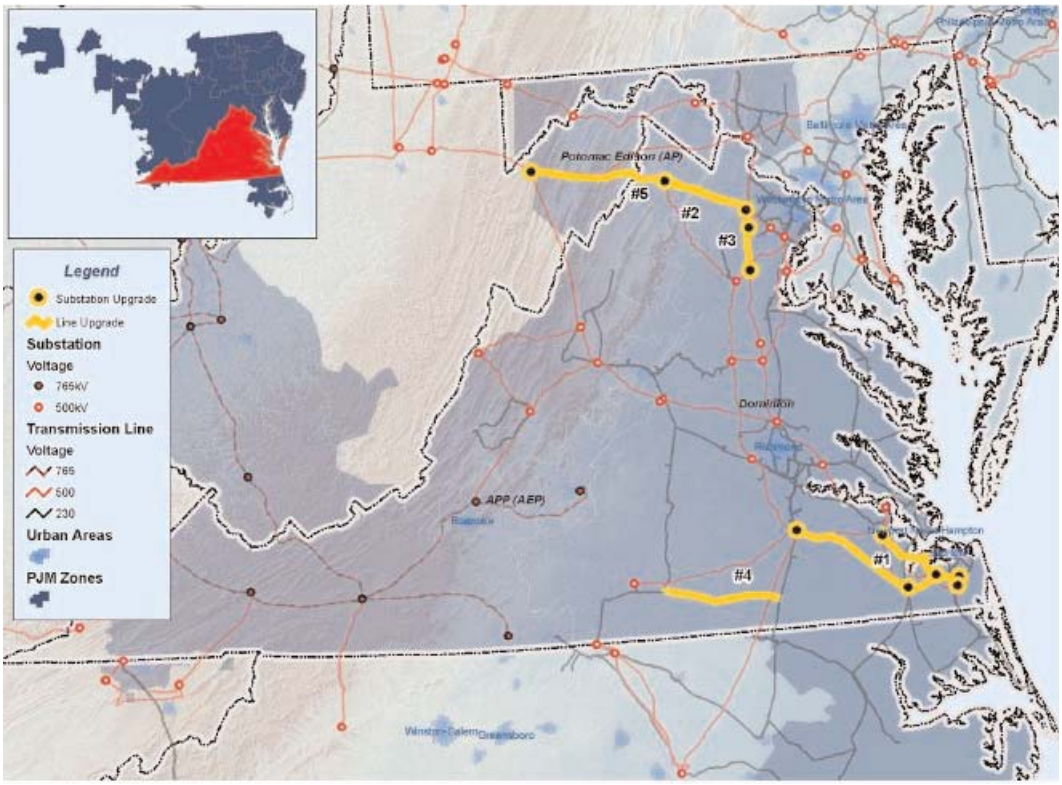
[64]"Wise County Site Chosen for Final Evaluation of Future Clean Coal Power Station in Virginia," Dominion Electric Power Company, news release, May 11, 2006 (www.dom.com/news/elec2006/pr0511.jsp).
[65]Bristol Herald Courier, March 27, 2007.
[66]Greg Edwards, "Gas-fired power plant for Warren Co.," Richmond Times Dispatch, March 15, 2007.

4.1.4 Existing Electric Transmission System

Electric power is distributed in Virginia through 500- and 765-kilovolt transmission lines. An intricate network of smaller, lower-voltage lines moves power from these high-voltage lines to consumers (see Figure 4-3).

Virginia's electrical network is an integral component of the regional network managed by PJM. PJM serves several important functions, including providing a regional power market for electric providers and maintaining the integrity and reliability of the grid. PJM ensures the reliability of the largest centrally dispatched electric grid in the world by coordinating the movement of electricity in thirteen states. PJM manages a regional planning process for generation and transmission expansion to ensure future electric reliability. It also facilitates a collaborative process for planning future transmission facilities for the region. Stakeholders include participants who produce, buy, sell, move, and regulate electricity.

Figure 4-3 Major Electric Transmission Line Systems in Virginia



Source: PJM.

The North American Electric Reliability Council, using information provided by eight regional reliability organizations, prepared its 2006 Long-Term Reliability Assessment for the period through 2015. Key findings in the 2006 report indicate that:

- Capacity margins continue to decline in most regions.
- Construction of new transmission facilities is slow and continues to face obstacles.
- Fuel supply and delivery are critical to reliability and must be evaluated.
- An aging design workforce and electric operations will challenge future reliability.

A U.S. Department of Energy (DOE) study of the nation's electric supplies found potential shortages in the eastern portion

of the Mid-Atlantic region. The study also found there is excess generation capacity west of this region, leading the DOE to propose the area from West Virginia and western Pennsylvania north to New York and south to northern Virginia as a National Interest Electric Transmission Corridor, or NIETC. The DOE states that in making such a designation it does not suggest that transmission is the only method for responding to the shortage; the intention of the designation is to make it easier to locate electric transmission facilities in the region. Virginia believes that the designation of a portion of Virginia as part of an NIETC could lengthen the decision-making process and would not meet the intent of the National Energy Policy Act of 2005.

Virginia has taken several actions since the federal DOE completed its congestion study on which it based the draft designation. The state enacted legislation in 2007 that includes incentives for construction of new generation facilities and provisions for recovery of federally approved transmission costs. The state also has enacted a new coordination process for projects requiring certification by both the State Corporation Commission (SCC) and Virginia's environmental agencies. This pre-application review process will provide for timely consideration of permitting and certification issues. Through these actions, Virginia will be able to implement policies that are most responsive to the needs of its electric consumers and consider the optimal mix of conservation, new generation, and new transmission facilities.

There is limited opportunity to construct new fossil-fueled generation in northern Virginia. The area is designated as non-compliance for ozone, and any new electric generation would have to be coupled with offsets of emissions from other sources in the region. Additionally, there are pressures to close older generating plants in the greater Washington, D.C., area. This would add to the supply deficit and result in the need for new transmission infrastructure in the region.

Studies of the capacity of Virginia's electric transmission system are undertaken as part of PJM's adequacy planning process. This process includes multiple stakeholders, among them electric utilities, consumers, public interest groups, and states and localities. PJM standards for system adequacy are based on North American Electricity Reliability Council standards. Virginia state government is represented by the SCC and the Consumer Assistance Division of the Office of the Attorney General. PJM has identified the need for greater involvement of state executive branch officials in the process. This Plan recommends that Virginia develop a coordinated approach among the SCC, the Office of the Attorney General, and the executive branch energy policy and environmental agencies to provide state input into PJM's planning process.

There is ongoing debate on whether new electric transmission lines should be constructed on overhead towers or placed underground. While there is general agreement that constructing transmission lines underground significantly increases the life-cycle costs of long-length transmission lines, it has been found to be cost effective in high-density population areas because of conflicts with other land uses. The Joint Commission on Technology and Science is evaluating aboveground verses underground placement of transmission lines. Today, localities in Virginia may set up a special taxing district to pay for the increased costs of placing electric transmission lines underground. However, there is considerable debate whether residents of the areas through which lines pass or users of the power from the lines should pay for these costs.

4.1.5 Planned Transmission System Additions

Several issues regarding Virginia's transmission system will need to be addressed over the next several years to maintain the reliability of the high-voltage system, meet load growth in critical areas, replace aging infrastructure, and facilitate new generator interconnections. Without

the addition of high-voltage projects, reliability and supply will reach a critical point by 2011.

As part of its ongoing responsibilities, PJM annually prepares a plan to address regional transmission needs. The 2006 Regional Transmission Expansion Plan recommends upgrades to address near-term needs within five years and assesses long-term needs that require a planning horizon of fifteen years or more. The plan also provides data on major upgrade plans approved prior to and during 2006. Allegheny Power and Dominion plan to construct 500- and 230-kilovolt facilities in Virginia (see below). Allegheny Power committed to the addition of a fourth 500- to 138-kilovolt autotransformer at its Meadowbrook station, scheduled to be installed in May 2008. Dominion proposed $14.8 million in transmission line and substation additions to be in service by June 2009 and identified an additional $698 million in 500- and 115-kilovolt projects to address voltage criteria violations in the Norfolk and Virginia Beach areas, along with various overloads on the 500-kilovolt system. A list of specific projects is available on the PJM website.

As noted above, Allegheny Power and Dominion have proposed building a high-voltage transmission line in Virginia as part of a 240-mile, 500-kilovolt line from southwest Pennsylvania. In proceedings before the SCC, Dominion noted that under normal load conditions the Purcellville load area would nearly exceed the capacity of the distribution circuits by summer 2011. With the loss of one of the four available circuits, the load will nearly exceed the capacity of the remaining three circuits by summer 2007 and will exceed it by 2008.

Dominion has stated that such overloads can be avoided only with increased transmission-line investment in the region or mandatory load curtailment actions such as rolling blackouts. PJM has concurred and asserts that without additional transmission capability, the urban load center that includes northern Virginia will become overloaded by 2011 and will be in violation of North American Electric Reliability Council and PJM reliability and planning criteria. Dominion has stated that if the new transmission line is not built, it may need to shed as much as 1,100 megawatts of load through rolling blackouts during peak periods in summer 2011, and as much as 1,700 megawatts in summer 2013. The company has proposed using a route along existing transmission corridors. The SCC has ultimate responsibility for certifying the need for increased electric transmission capacity and for approving the route. It will make a final decision on the proposed route for this new transmission line later in 2007 or 2008.[67]

Table 4-4 shows the estimated transmission system expenditures by year for 2009-2011 for Dominion and Allegheny Power.[68]

Table 4-4 Projected Transmission System Expenditures

Year	Dominion Virginia Power ($ in Millions)	Allegheny Power Company ($ in Millions)
2009	$39	
2010	$30	
2011	$300	$342

[67]Virginia SCC, case no. PUE-2005-00018, Commission Order Remanding for Further Proceedings, February 21, 2007.
[68]Ibid.

4.1.6 Opportunities and Challenges

Virginia will continue to need new and upgraded electric distribution systems. This will require an ongoing investment by the state's electric utilities to meet growing system needs and ensure reliability of supply.

Obtaining the necessary permits and licenses to build new electric generation and transmission facilities can be a lengthy and expensive process. At the workshops held in 2006 to develop this energy plan, many of the participants identified this as an area that needs improving. Virginia's recently enacted legislation, effective on July 1, 2007, creates a coordinated process for reviewing applications for new energy facilities such as power plants and codifies recommendations from the SCC and Secretary of Natural Resources report on how to streamline the permitting process.

While Virginia recognizes that electric-supply issues cross state lines and require assessment across a multistate region, decisions regarding the routing of transmission lines should continue to be made at the state level.

Virginia has the potential for renewable electric generation from solar, onshore and offshore wind, run-of-stream hydropower, and waste- or biomass-fired facilities. There has been considerable debate about the appropriateness of onshore wind development in Virginia and other states. Localities should consider both the potential value to increasing the diversity of their electric supply and the visual and community effects of such projects. Community associations and localities are encouraged to consider the results of the state system to rate a property's suitability for solar and wind development when considering approval of such uses. Local governments and community associations also should provide property owners with a clear set of guidelines for renewable energy projects and should allow for the installation of solar thermal or photovoltaic panels that are integrated into a facility's design.

Virginia authorized two grant programs in 2006 to support development of alternate energy supplies, but the programs have not been funded. The Renewable Electricity Production Grant Program was designed to support utility-scale generation of electric power from renewable sources. The Photovoltaic, Solar, and Wind Energy Utilization Grant Program would support small generators. Since small generators would not receive any financial incentive from Virginia's renewable portfolio standard (see Chapter 2 for a discussion of Virginia's renewable portfolio standard), the state should first, to the extent resources are available, fund the Photovoltaic, Solar, and Wind Energy Utilization Grant Program.

While Virginia recognizes that electric-supply issues cross state lines and require assessment across a multistate region, decisions regarding the routing of transmission lines should continue to be made at the state level. Federal eminent domain should not be used to locate an electric transmission line. Additionally, it should be clarified that the prohibition against using federal eminent domain over state property includes a prohibition against overturning state-owned conservation easements.

An electric transmission-line developer may apply to the Federal Energy Regulatory Commission for approval to construct a line in a designated National Interest Electric Transmission Corridor if Virginia or neighboring states fail to approve the construction of a line within twelve months of submitting a complete application to the state. Virginia will be challenged to complete its review of any transmission-line application within twelve months, particularly with complex or long-distance projects. Companies applying for approval to construct a transmission line should complete sufficient pre-application work to address the full range of possible issues associated with their application. Applicants should take full advantage of the pre-application planning process established by 2007 state legislation.[69] This will narrow the issues to be considered and increase the likelihood of completing the permit review within the one-year limit.

PJM is responsible for ensuring that adequate electric supplies are available to meet future electric demand consistent with North American Electric Reliability

[69]For information, see Senate Document 22, 2006, Coordinating the Review of Energy Facilities (http://leg2.state.va.us/DLS/H&SDocs.NSF/4d54200d7e28716385256ec1004f3130/1eb821c475a805868525715b0048201b?OpenDocument) and §56-46.1.H of the Code of Virginia.

In 2007 Virginia enacted amendments to its electric utility regulation laws. The new legislation includes investment recovery mechanisms for new plant and infrastructure construction, incentives for using renewable sources, and a goal for electric conservation and demand-reduction programs.

Council requirements. It considers conservation and demand-control activities as reliable and guaranteed only if they are under binding contract to utilities in the region. PJM should investigate the reliability of accepting a broad portfolio of conservation and demand-control program portfolios when assessing future loads. Further analysis should help determine the reliability of conservation and demand-control programs when calculating load forecasts.

Virginia can better coordinate among the SCC, Office of the Attorney General, and executive branch energy and environmental agencies how to provide state input into the PJM and North American Electric Reliability Council planning processes.

Virginia, through the Joint Commission on Technology and Science, is evaluating aboveground verses underground placement of transmission lines. Use of underground verses overhead electric transmission lines raises many questions regarding cost of constructing and operating the lines, who benefits, who should pay for any increased costs, and reliability. Through this process, Virginia stakeholders can reach agreement when the costs of placing lines underground rather than aboveground are in the public interest.

In 2007 Virginia enacted amendments to its electric utility regulation laws. The new legislation includes investment recovery mechanisms for new plant and infrastructure construction, incentives for using renewable sources, and a goal for electric conservation and demand-reduction programs. Under the new law, a utility will be permitted to earn a rate-of-return bonus for developing new base-load capacity. The law also provides for a rate-of-return bonus for nuclear, carbon-capture compatible, clean-coal, and renewable projects. If a utility does not offer a 100 percent renewable energy retail product to its customers by the end of the rate-cap period, a licensed retailer can offer such a product to all classes of customers.

4.2 Natural Gas

4.2.1 Existing Infrastructure

Natural gas is a versatile fuel that adapts to a wide range of uses and helps meet the energy needs of residential, commercial, and industrial customers. Virginia's natural gas utilities serve more than a million residential (approximately 37 percent of households) and 90,000 commercial natural gas customers. The state produces about 85 billion cubic feet of natural gas per year and has a demand of approximately three times that amount.[70] With increasing demand from homes and businesses, as well as from new gas-fired power plants, new supplies will be needed over the next decade.

Virginia's natural gas is supplied through three primary routes: pipelines from the Gulf of Mexico region, liquefied natural gas (LNG) imports through Cove Point, Maryland, and natural gas produced or stored in southwest Virginia. Natural formations suitable for natural gas storage are being used in Smyth County near Saltville and in Washington and Scott Counties.

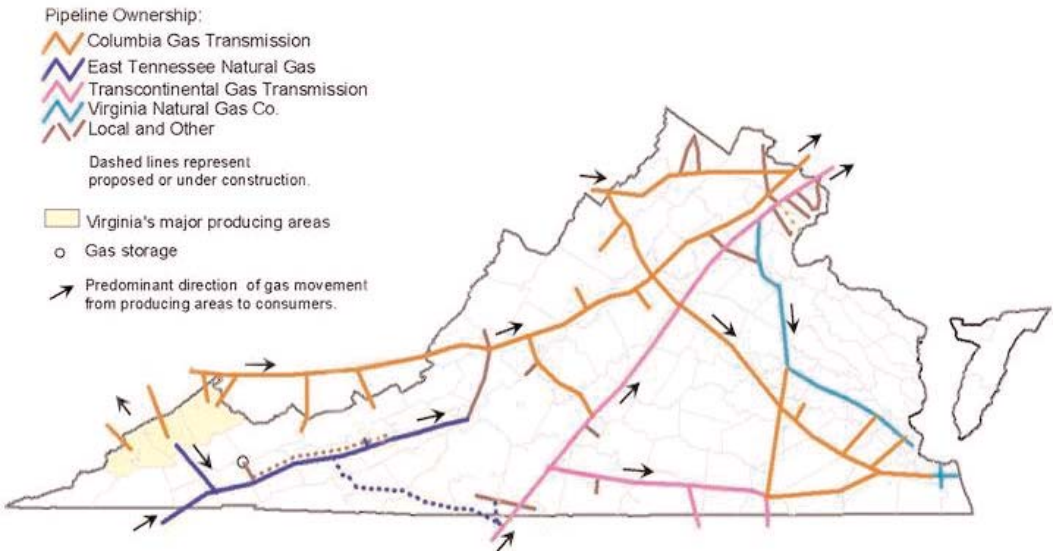
Virginia also is home to local natural gas storage facilities designed to serve peak load. These hold natural gas, propane, or LNG in tanks or underground caverns for delivery into the local distribution pipeline system to meet peak natural gas demand.

Industrial customers and gas-distribution utilities withdraw gas from the interstate pipeline network and storage facilities to supply their factories, homes and businesses within local service areas.

Virginia's infrastructure for distributing and transporting natural gas consists of more than 1,200 miles of interstate gas pipelines and 22,000 miles of other natural gas pipelines (see Figure 4-4).[71]

[70]"Virginia's Natural Gas Infrastructure Needs," presentation by James Kibler to the State of Virginia DMME Energy Plan Working Group, September 11, 2006.
[71]Virginia Energy Patterns and Trends: Major Natural Gas Pipelines (www.energy.vt.edu/vept/naturalgas/NG_pipelines.asp) . More detailed statistics on natural gas pipelines in Virginia are available on the website of the Office of Pipeline Safety Program of the U.S. Department of Transportation.

Figure 4-4 Major Natural Gas Pipelines In Virginia



Virginia's natural gas utilities serve more than a million residential (approximately 37 percent of house-holds) and 90,000 commercial natural gas customers.

Virginia's infra-structure for distributing and transporting natural gas consists of more than 1,200 miles of interstate gas pipelines and 22,000 miles of other natural gas pipelines (see Figure 4-4).

Because of pipeline system limits, the Cove Point, Maryland, LNG import facility has primarily served northern Virginia and the Virginia peninsula. Ongoing expansion at Cove Point has increased its capacity to serve other Virginia markets. The recent construction of the natural gas pipeline from southwest Virginia's coalfields to the Duke Energy/East Tennessee Natural Gas pipeline near Saltville has increased the ability to supply Virginia-produced natural gas to the Roanoke area and other localities along the Virginia-Tennessee border.

4.2.2 Adequacy of Natural Gas System Infrastructure

As a result of the growth in demand for natural gas both nationally and in Virginia since the late 1990s, new infrastructure is needed. Current market conditions show there is an imbalance between natural gas demand and the supplies needed to support Virginia's and the nation's economy. For example, demand for natural gas has grown 30 percent over the past ten years in the Virginia Natural Gas service area-twice the national average. Pipeline system reliability is also crucial to military facilities in the Virginia Natural Gas service area, among them the Norfolk Naval Station, Oceana Naval Air Station, Little Creek Amphibious Base, Dam Neck Naval Training Station, and Fort Story. Other infrastructure improvements will be needed in other regions of Virginia as the state's economy and natural gas use grows.

New pipeline projects are difficult to develop. Pipeline developers need to have contracts for a substantial amount of a proposed pipeline's capacity before committing to construction. This was seen in the difficulties in developing and termination of the Homestead, Tidewater, and Greenbrier pipeline projects. This can result in some natural gas transmission constraints being unsolved.

Natural gas service in Virginia is also affected by upstream constraints that increase natural gas costs to consumers and lessen reliability. This was illustrated by the problems in natural gas markets after the 2005 Gulf of Mexico hurricanes. These upstream constraints must be addressed to reduce the risk of future natural gas supply problems in Virginia.

4.2.3 Planned Natural Gas Facilities

Several new natural gas pipelines have been proposed or are under construction in Virginia. Duke Energy is constructing

One possible source for diversifying Virginia's natural gas supplies is offshore natural gas production. The U.S. Minerals Management Service (MMS) has included the potential for one special lease sale in waters at least 50 miles off Virginia's coast.

the Patriot pipeline upgrade from Tennessee toward Roanoke and extension from Henry County into North Carolina.

In August 2006 the State Corporation Commission directed Virginia Natural Gas to construct a pipeline under the Hampton Roads harbor from Newport News to Norfolk to connect its northern and southern gas distribution systems. The Hampton Roads Crossing (HRX) pipeline will ensure a reliable and competitively priced supply to meet the rapid population growth in the region and the resulting demand for natural gas. Virginia Natural Gas currently estimates that the project will cost between $48 and $60 million to serve its service territory, and more if it is expanded to serve additional natural gas utilities.

The HRX pipeline will include construction of approximately 10 miles of onshore pipeline, and 10 miles crossing the Hampton Roads harbor. It will also include upstream pipeline compression facilities in Hanover and Charles City Counties, and a city gate station at the termination point in Norfolk.

Scheduled to be completed with initial deliveries of gas into Norfolk by late 2009, the project is designed to transport up to 100,000 decatherms per day of additional capacity into the Virginia Natural Gas distribution system, as well as additional capacity to industrial users and neighboring distribution companies.

Dominion has received approval from the Federal Energy Regulatory Commission to further expand its facilities at the Cove Point LNG terminal.

At Saltville, the storage field capacity that began service in August 2003 has increased substantially since 2004. Working gas storage capacity has grown from 2.1 billion cubic feet to 5.8; daily injection capacity has increased from 104 million cubic feet to 220; and daily withdrawal capacity has increased from 208 million cubic feet to 486.[72] The Saltville natural gas storage facility operator signed an agreement in June 2007 with a salt mining company to develop additional storage capacity in the future.

Virginia's natural gas local distribution utilities regularly need to build additional local distribution network pipes to serve newly developed areas. The local distribution companies also periodically need to build new peak storage facilities to serve expanding loads.

4.2.4 Opportunities and Challenges

Virginia should carefully consider support for projects to diversify its natural gas supplies, such as new LNG terminals and increasing pipeline capacity.

Additional capacity improvements to gas pipelines across the southeastern portion of the state could be added, or additional storage for peak use could be added. State and regional energy and economic development entities should monitor natural gas supply and demand and work with local utilities and pipelines to ensure that an adequate supply infrastructure is maintained.

Virginia has the geography and the market to make the Hampton Roads area an attractive expansion target for both new LNG storage and import. LNG supply, storage, and distribution would itself represent a major industry expansion and would bring new gas supplies to this area for industrial use.

Virginia's natural gas utilities must replace old infrastructure, such as old pipe, fittings, valves, and other equipment, to maintain reliable service. This requires ongoing investments that must be recovered from ratepayers.

One possible source for diversifying Virginia's natural gas supplies is offshore natural gas production. The U.S. Minerals Management Service (MMS) has included the potential for one special lease sale in waters at least 50 miles off Virginia's coast.

The Virginia legislature has recently examined opportunities for drilling for new oil and natural gas supplies on the outer continental shelf.[73] Virginia's off-shore areas have been subject to limited federal, state, and industry resource

[72]Source: www.ferc.gov/industries/gas/indus-act/storage/certificated-for-expansion.pdf.
[73]See http://leg2.state.va.us/dls/h&sdocs.nsf/4d54200d7e28716385256ec1004f3130/314f8feb1408441285256fcd004e4d6d?OpenDocument.

assessments. These studies show the geology in this area to be gas prone, although the presence of economically recoverable supplies is not assured. In addition, the presence of oil cannot be ruled out. Further geophysical exploration and drilling will be necessary to determine whether economically recoverable natural gas or oil exists. The federal government estimates there may be 33.3 trillion cubic feet of natural gas and 3.5 billion barrels of oil in the Atlantic outer continental shelf. On a pro rata basis, this would total about 11.7 trillion cubic feet of gas and 1.2 billion barrels of oil in the Mid-Atlantic area. Royalty estimates depend on the amount of resources recoverable and the cost of gas or oil. There could be from zero to more than $10 billion in total value of natural gas in Virginia offshore administrative boundary areas.

Any development of this resource should be made consistent with Virginia policy. This policy states that the federal government should only proceed with exploration of natural gas more than 50 miles from the state's shoreline. Both the MMS, through its five-year offshore plans, and the National Oceanographic and Atmospheric Administration, through the Coastal Zone Management program, should recognize this policy when taking action affecting offshore development. The MMS should also work with the offshore exploration and production industry and the state to determine the extent of offshore natural gas resources and the environmental protections that would be needed for such development.

4.3 Petroleum

4.3.1 Existing Infrastructure

Gasoline, diesel, and other petroleum products are distributed through a network of pipelines and terminals located in and around Virginia and neighboring states. As the marketplace for fuels expands to include new products such as low-sulfur fuels and non-petroleum alternate fuels, petroleum terminals must reconfigure their facilities to manage the new products.

Developing alternate fuels such as ethanol and biodiesel will require developing new fuel production and transportation facilities. Other infrastructure will be needed to supply raw material inputs, such as biomass supplies. Virginia has a production incentive grant for in-state produced biofuels (see Section 4.8, Alternative Fuels Production, below).

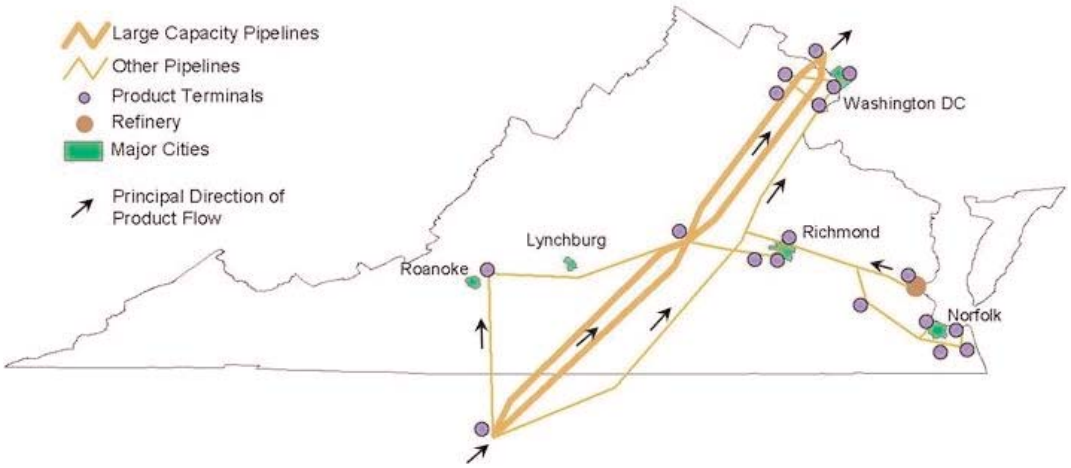
Although Virginia does produce oil and petroleum products, in-state production accounts for only a small portion of the state's consumption. All of the oil production occurs in Lee and Wise Counties. Oil production is primarily a byproduct of natural gas extraction efforts from deep geological reservoirs containing both natural gas deposits and small amounts of crude oil. Virginia's one oil refinery, at Yorktown, has a production capacity of 58,600 barrels of petroleum products per calendar day, which ranks 89th out of 144 U.S. refineries.

4.3.2 Distribution Network: Oil Pipelines

Virginia imports nearly all of its petroleum products (gasoline, diesel, and heating and jet fuels), primarily from refineries in the Gulf Coast, through the Colonial and Plantation pipelines. The Plantation pipeline ends at Reagan Washington National Airport in Arlington County, whereas the Colonial pipeline stretches north into northern New Jersey (see Figure 4-5).[74]

[74]Virginia Energy Patterns and Trends: Major Petroleum Product Pipelines (www.energy.vt.edu/vept/petroleum/oil_pipeline.asp).

Figure 4-5 Major Petroleum Pipelines and Terminals in Virginia



Petroleum products also arrive in Virginia via ocean tanker and barge. The ships and barges primarily serve the petroleum terminals in Chesapeake.

Pipelines, barges, and ocean tankers can transport many different types of petroleum products. Once they bring petroleum into Virginia, it is stored in bulk storage at terminals. Large bulk storage terminals for petroleum products are located in Richmond, Chesapeake, the Roanoke area, and northern Virginia. Petroleum jobbers have smaller storage sites throughout the state. Local dealers often have some limited on-site storage capacity. There is also a large break-out tank farm in Cumberland County along the major pipeline corridor that serves to balance supplies and make up pipeline supply deficiencies in Virginia and points northward.

Some products cannot be transported via pipeline. Ethanol, for example, is transported via barge, rail, or tanker truck and must be stored in separate, dedicated tanks. Ethanol is mixed with pipeline product (referred to as reformulated gasoline blendstock for oxygen blending, or RBOB) at a terminal to make reformulated gasoline.[75] As summer approaches, distributors switch to products that are specially blended for summer weather conditions. When making this switch, it is necessary to have a completely empty storage tank before filling with the summer blend product.

Petroleum products are distributed from a terminal to retailers by tanker truck. Transport companies are either retailer operated or independent trucking firms specializing in liquid fuels. In Virginia, retailers of petroleum products include convenience-store chains owned by refiner and distributor companies, and small independently owned businesses.

4.3.3 Adequacy of Petroleum Infrastructure

The large amount and diverse array of petroleum products imported into the state are constrained by the number of terminals and their storage capacity. There are few options for building new terminals or refineries because the Virginia coastline is already well developed, and new port sites and land for refineries near ports do not exist. There is, however, potential for building new tanks at existing terminals and for expanding the existing refinery. Several factors complicate such growth, however, including public concerns about locating new industrial facilities, the number of different fuels needed, and associated tank requirements.

[75]RBOB is a petroleum product that conforms to industry standards for reformulated regular gasoline blendstock for blending with 10% denatured fuel ethanol (92% purity). It is a wholesale non-oxygenated blendstock ready for the addition of 10% ethanol at the truck rack.

Virginia has the potential to develop an alternative fuels industry. Virginia-derived alternative fuels could reduce demand for conventional petroleum products and alleviate a portion of import needs and supply challenges

4.3.4 Opportunities and Challenges

The primary supply improvement available is expansion of the Yorktown refinery. Virginia made permanent the sales-tax exemption to supplies and equipment for this refinery to help its owner obtain financing for an expansion project. State and regional economic development entities should continue to work with the owner to provide all cost-justified assistance to this expansion.

Terminal expansion and modifications are required as a result of new fuel standards and products. Additionally, as alternative fuel markets develop, new storage and distribution infrastructure will be required. Local governments should, consistent with public health and safety protection needs, streamline approval of modification plans and provide all available flexibility to terminal operators to make these needed changes.

Virginia has not supported exploration and development of offshore oil. Although drilling may be the only way to determine if offshore oil resources are present, developing these resources exposes Virginia's world-class coastal resources to greater risk than natural gas development. If offshore oil deposits are found, Virginia and the federal government should work with stakeholders to evaluate the increased risk and protections that would be needed before any further development is approved.

Virginia has the potential to develop an alternative fuels industry. Virginia-derived alternative fuels could reduce demand for conventional petroleum products and alleviate a portion of import needs and supply challenges (see Section 4.8 below).

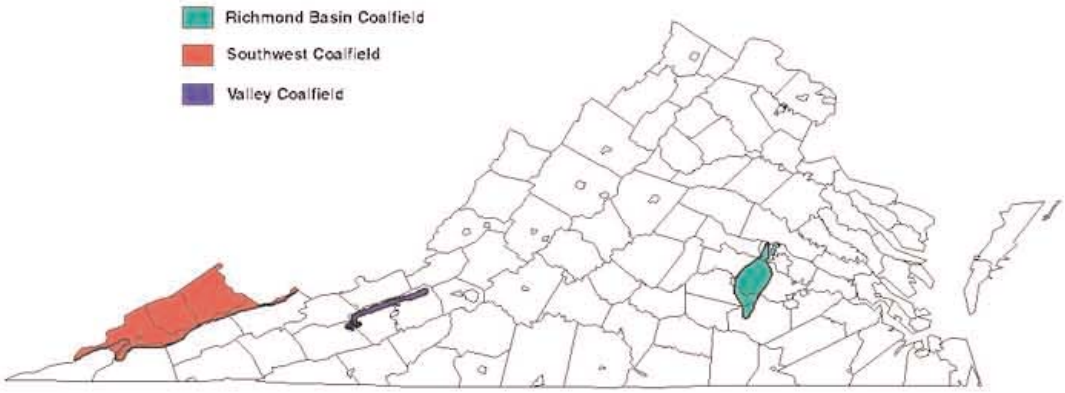
4.4 Coal Mining

4.4.1 Existing Infrastructure

Coal Mines

All Virginia coal is produced today in southwest Virginia (see Figure 4-6).[76] Production peaked in 1990 at 46.5 million tons and since then has decreased by 42 percent. By 2006, production had declined to approximately 32 million tons. Virginia's coal mining industry employed more than 4,700 people in 2005. Table 4-5 provides data on production and employment trends from 1996 to 2005.[77]

Figure 4-6 Virginia's Coalfields



[76]Virginia Energy Patterns and Trends: Existing Coal Fields (www.energy.vt.edu/vept/coal/basins.asp).
[77]Virginia Energy Patterns and Trends: Production and Employment Data by Mine Size (Coal) (www.energy.vt.edu/vept/coal/minesize.asp).

Table 4-5 Coal Mine Trends, 1996-2005

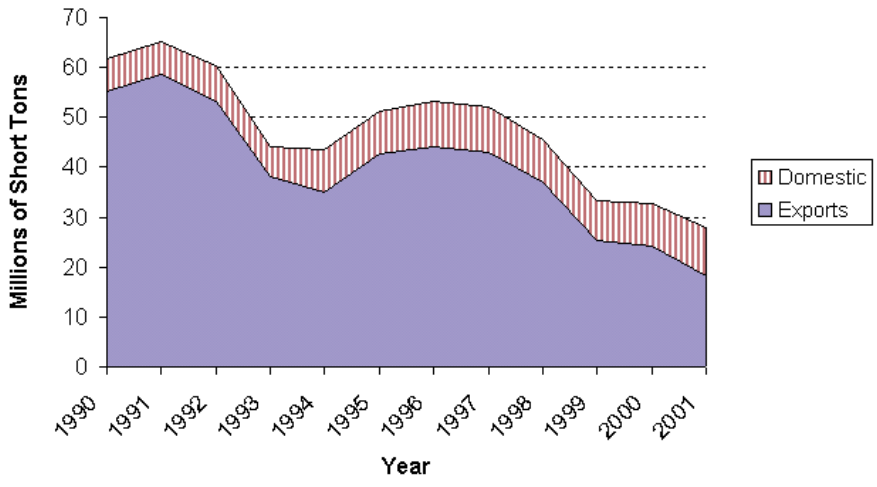
Year	Number of Mines	Short Tons Produced	Number of Employees
1996	325	36,725,571	6,089
1997	355	36,889,161	6,534
1998	352	34,001,907	5,802
1999	361	32,253,994	5,456
2000	341	33,210,226	4,926
2001	327	32,600,564	5,261
2002	323	31,746,140	4,956
2003	295	31,445,858	4,353
2004	292	30,486,961	4,501
2005	265	26,937,574	4,764

The Commonwealth and Virginia's coal industry should work together to maintain a viable mining industry that supports the economy in southwest Virginia and provides needed coal resources for electric and steel production at reasonable costs to consumers. This includes maintaining safe conditions for mine workers (e.g., working to implement changes in federal mine safety law related to mine rescue, emergency supplies in mines, underground miner tracking and communication systems, and seals used in underground mines) and controlling effects of coal mining on the environment.

Distribution Network

The vast majority of Virginia coal is shipped from mine to market and ports by rail. The Port of Hampton Roads, at the mouth of Chesapeake Bay, can load more than 65 million tons annually and is one of the largest and most efficient coal-shipping facilities in the world. The facilities handle coal mined in Virginia, West Virginia, and Kentucky. The markets for this coal include electric generators located close to East Coast shipping lanes and overseas purchasers. Figure 4-7 shows trends for coal shipments from the Port of Hampton Roads from 1990 to 2001.[78]

Figure 4-7 Coal Shipments from Port of Hampton Roads, 1990-2001



[78]Virginia Energy Patterns and Trends: Coal Shipments from the Port of Hampton Roads (www.energy.vt.edu/vept/coal/basins.asp).

According to 2005 data from the Energy Information Administration, municipal solid waste plants generated more than 1 million megawatt-hours of energy, and landfill gas plants approximately 97,500 megawatt-hours.

There have been conflicts between utilities, coal producers, and coal-hauling railroads about transporting coal. Utilities and coal producers have complained about the lack of competition due to being captive shippers, resulting in high shipping costs. There have periodically been problems with availability of coal cars for moving coal from mine to markets. Rail shipping rates are governed by the federal government. The Federal Railroad Commission should ensure that coal transportation rates are fair to users while providing an adequate return to railroad companies to ensure adequate investment in infrastructure.

4.4.2 Adequacy of Infrastructure

The coal-related road and rail infrastructure is generally adequate. The biggest infrastructure challenge is a congested and constrained rail system and the growing competition for rail. The demand for rail will continue to grow as efforts to move truck freight to rail increase.

4.4.3 Opportunities and Challenges

Virginia has the opportunity to import coal from sources such as South America to provide the lowest-possible-cost coal supplies to utility and industrial users. While Virginia should not take actions that would diminish the viability of southwest Virginia coal producers, Virginia utility consumers will benefit from the market diversity provided from coal imports. Virginia should therefore provide the approvals necessary to modify existing coal-export facilities to accept coal imports.

Local governments in southwest Virginia are encouraged to continue using local coalfield road improvement funds to ensure that there are adequate roads to haul coal on routes that minimize conflict with built-up areas. Virginia's rail providers are encouraged to continue efforts to supply adequate rail-car capacity to carry coal from Virginia's mines to end-users and Virginia's coal-export ports.

4.5 Propane

4.5.1 Existing Infrastructure

Consumers in Virginia used approximately 229 million gallons of propane in 2004, the latest year for which propane consumption data are available.[79] The 2000 U.S. Census reports that 5.1 percent of households in Virginia use propane or bottled gas for space heating. Propane consumption in Virginia has remained fairly flat for several years.

The majority of Virginia's propane gas is supplied by an interstate propane pipeline that terminates in Apex, North Carolina. Tanker trucks fill up at the terminal in Apex and then bring the supplies to Virginia. Propane also is delivered via railroad cars, barges, and tankers. Propane gas supply is generally stored in large aboveground tanks at distribution facilities. There are fifty-three Virginia-based distributors and eight multistate distributors serving the state.

4.5.2 Planned Propane Facilities

The Virginia Propane Gas Association reports that Virginia's propane supply capacity is on the increase. Many members of the association are adding extra 30,000-gallon storage tanks to their current bulk storage facilities. Several are even adding new bulk plants.[80]

In 2007 the National Propane Gas Association began charging membership dues based on the number of bulk propane storage tanks per company, rather than on the number of office locations. Accordingly, up-to-date data on the total number of bulk storage plants in Virginia will be readily available beginning in 2008.

4.6 Biomass/Waste

4.6.1 Existing Infrastructure

Virginia has several plants that convert waste and biomass into energy. The largest is Covanta's I-95 Energy/Resource Recovery Facility which began operation in 1990. It processes 3,000 tons per day of

[79]Source: American Petroleum Institute.
[80]E-mail from Mary Howell of the Virginia Propane Gas Association, May 14, 2007.

Significant resources exist to support additional biomass or waste-to-energy infrastructure projects. With the potential to grow energy crops on farmland, coupled with resources that include more than fifty operating landfills and 16 million acres of forestland, Virginia clearly has adequate resources.

municipal solid waste and has a generating capacity of 79 megawatts of electricity. This renewable energy is distributed through Dominion and provides enough energy to meet the needs of 75,000 homes. Covanta's Alexandria/Arlington Resource Recovery Facility in northern Virginia processes 975 tons of waste per day and has a generating capacity of 23 megawatts. The Southeast Public Service Authority operates a municipal solid waste plant in Portsmouth that is designed to process 1,500 tons per day. It produces process steam and electricity for the Norfolk Naval Shipyard and sells excess electricity to Dominion. Other waste-to-energy plants operate in Harrisonburg, Salem, and Hampton.

Other plants extract landfill gas/methane (the primary molecular component in natural gas) from in-situ waste to drive electric generators or to fuel nearby public and industrial facilities. According to data from the Environmental Protection Agency's Landfill Methane Outreach Program, Virginia has nineteen operational landfill gas projects. Ten of these use methane for generating electricity and have a combined capacity of more than 30 megawatts. Two are under construction with a 7-megawatt capacity. The remaining nine burn methane to drive thermal energy processes.

According to 2005 data from the Energy Information Administration, municipal solid waste plants generated more than 1 million megawatt-hours of energy, and landfill gas plants approximately 97,500 megawatt-hours.[81]

Several energy plants use wood or wood wastes as fuel sources. The largest such facility is in Pittsylvania County and is owned and operated by Dominion. It consists of three boilers and one 80-megawatt turbine unit and consumes about 750,000 tons of wood per year.

4.6.2 Adequacy of Biomass/Waste Resources

Significant resources exist to support additional biomass or waste-to-energy infrastructure projects. With the potential to grow energy crops on farmland, coupled with resources that include more than fifty operating landfills and 16 million acres of forestland, Virginia clearly has adequate resources.

In October 2006, Virginia Tech's Department of Wood Science and Forest Products published the Assessment of Virginia's Bio-Energy Resources, Wood Residues Using GIS to evaluate Virginia's "types, quantities, and location of wood residues and other woody materials that could be available for use as bio-energy or other applications." The study found that primary manufacturers produced an estimated 7.5 million tons of Virginia biomass residues in 2003, approximately 90 percent of which came from sawmills. Secondary manufacturers produced an estimated 570,000 tons of Virginia's biomass residues in 2003. Nottoway, Pittsylvania, Rockbridge, Augusta, and Caroline were the state's top five residue-producing counties. This research indicated that responding Virginia landfill facilities received approximately 10.8 million tons of waste in 2003, of which 1.2 million tons were solid wood.

The total estimated forest residue production from Virginia in 2003 was 756,000 tons.

4.6.3 Planned Biomass/Waste Facilities

The 585-megawatt Virginia City Hybrid Energy Center proposed in Wise County is being designed to co-fire as much as 20 percent from biomass.

Biomass and waste are potential feedstock for the alternative liquid fuel industry. More information on this is provided below in Section 4.8.

4.6.4 Opportunities and Challenges

Virginia electric utility re-regulation legislation enacted in 2007 includes incentives for renewable generation, including firing or co-firing of biomass. It is anticipated that much of the capacity required to meet the goals of the legisla-

[81] EIA Form 960 Annual Data Files.

Virginia electric utility re-regulation legislation enacted in 2007 includes incentives for renewable generation, including firing or co-firing of biomass. It is anticipated that much of the capacity required to meet the goals of the legislation will, at least initially, come through biomass-fired generation. This will create a demand for fuel and will result in new markets for one of Virginia's greatest resources.

tion will, at least initially, come through biomass-fired generation. This will create a demand for fuel and will result in new markets for one of Virginia's greatest resources.

Virginia is rich in biomass resources, including forestry products, waste wood from construction and wood products production, animal manures, energy crops such as switchgrass and soybeans, among others. The Virginia Biomass Energy Group, a collaboration of farmers, government officials, university researchers, businesses, and other stakeholders, is currently working to identify and quantify the state's biomass resources and to develop environmentally and economically viable strategies for increasing their use.

A December 2005 report prepared by the Virginia Center for Coal and Energy Research found there is a technical potential for energy from biomass of about 760 megawatts of electrical generation, with more than 500 megawatts coming from forest residues. Other biomass sources include urban wood residues (180 megawatts), unused mill residues (14.5 megawatts), crop residues (32.8 megawatts), and animal manure (12.3 megawatts). The study states that while landfill gas generators are among the lowest-cost renewables, Virginia has limited resources to develop, with only about 30 megawatts of additional potential generation capacity in existing landfills.

4.7 Renewable Energy Infrastructure–Wind Power

A predominant issue associated with renewable energy infrastructure is the siting of utility-scale wind turbines. There is no current utility-scale wind infrastructure in Virginia. While individual site assessments will be required for individual projects, adequate sites in high-wind-resource areas exist, both land based and offshore (see Chapter 2) to support utility-scale wind power use in Virginia.

4.7.1 Planned Wind Facilities

Highland New Wind Development LLC has proposed building up to twenty 2-megawatt turbines in western Highland County. The facility would be rated at just under 40-megawatt capacity and would be Virginia's first commercial wind project, producing more than 100 million kilowatt-hours annually (based on a 30 percent capacity factor).

James Madison University is conducting a feasibility study to determine whether a small number of utility-scale wind turbines are a viable option to meet a significant portion of electrical load at Tangier Island and export the excess wind power produced to the mainland. Power to the island is fed via a submerged cable from Accomack County on the eastern shore. This cable continues on to Smith Island, north of Tangier. The output from a community-scale wind power project could serve one or both islands, or could be sold to a third party such as a federal facility or manufacturer interested in procuring green power. This could provide a model for a small community co-op that others could learn from and replicate.

Several wind developers are exploring potential projects in the western and southwestern sections of the state.

4.7.2 Opportunities and Challenges

The application process to construct the Highland wind farm began in late 2005. In 2006, a Highland County District Court judge ruled that the Highland County Board of Supervisors followed proper procedure when it issued a conditional-use permit for the 400-foot-tall turbines. The judge also ruled that the project complies with the county's height ordinance and comprehensive plan. The Virginia Supreme Court will hear an appeal of the District Court decision, with a ruling anticipated in September 2007.

The wind farm also must receive a Certificate of Public Convenience and Necessity from the State Corporation Commission (SCC). In April 2007 the SCC judges sent the case back to the hearing examiner to reexamine the environmental

Initial reviews find Virginia has substantial potential for developing offshore wind resources beyond the normally visible horizon.

impact of the proposed turbines on various bird species. The order remanding the case noted that the wind farm would provide economic benefits and not harm grid reliability or competition, but that more analysis is needed to determine what, if any, mitigation might be required regarding the project's impact on bats and birds.

Virginia is implementing a Virginia Renewables Scoring System for siting Virginia renewable energy resources. This system ascribes numerical scores to parcels of real property based on the suitability of a wind or solar energy facility. The scoring system considers wind characteristics, proximity to electric power transmission systems, impacts to natural and historic resources and to economically disadvantaged or minority communities, and compatibility with local land-use plans. The scoring system uses GIS data sets that include wildlife, cultural, historical, economic, technical, and other aspects of the landscape.

Local governments also can adopt a local wind ordinance. Rockingham County has adopted a model local wind-energy ordinance developed with the Virginia Wind Energy Collaborative. The federal Department of Energy's Wind Powering America program has identified Virginia as a priority state and is supporting the Virginia collaborative.

In response to authority in the federal Energy Policy Act of 2005, the Minerals Management Service (MMS) is implementing an Outer Continental Shelf Alternative Energy and Alternate Use Program. The program is focused on those alternative energy technologies, including offshore wind, wave, and ocean current capture technologies, and offshore areas that industry has expressed an interest in developing in the 2007-2014 timeframe. The program will address the environmental impacts by including stipulations for data collection, facility siting, mitigation, and ongoing impact evaluation and will provide a roadmap for developers to follow during the permitting process, facilitating faster development of the alternative energy industry on the outer continental shelf.[82] The MMS anticipates receiving applications for development of these technologies over the next five to seven years.

It is Virginia's policy to support federal efforts to examine the feasibility of offshore wind energy being used in an environmentally responsible fashion. Initial reviews find Virginia has substantial potential for developing offshore wind resources beyond the normally visible horizon. Virginia is providing initial support for analysis through the Virginia Coastal Energy Research Consortium. This study will be undertaken jointly with the state's research universities, the wind power industry, and Virginia's electric utilities.

Virginia-based wind developments could increase the likelihood of wind-based business expansion in Virginia. General Electric has a facility in Salem that makes turbine components. The state could attract new wind-related businesses with a commitment to the industry and a local market for wind-energy products.

4.8 Alternative Fuels Production

Through rapidly advancing conversion technologies, biomass products, coal, and waste can be used to manufacture alternative liquid fuels.

Alternative fuels help meet goals associated with reducing environmental impacts. An alternative fuels industry would add diversity to a transportation sector that is completely dominated by petroleum. Supply diversity reduces risk and enhances energy security.

As part of its effort to reduce reliance on petroleum, improve the environment, and bring economic development to the coalfields and agricultural communities, Virginia can work to develop an alternative liquid fuel industry. Virginia's strategic advantages include proximity to markets and population centers, natural and waste resources for feedstock, Department of Defense presence and its eagerness to develop military-specification synthetic

[82]See http://ocsenergy.anl.gov/documents/dpeis/Alt_Energy_DPEIS_Executive_Summary.pdf.

fuels, and related research and development capacity (see Chapter 6).

4.8.1 Existing Infrastructure

Virginia currently is home to several small biodiesel refineries. Three produce biodiesel from soy, and a few others produce biodiesel from waste grease and oils.

4.8.2 Planned Alternative Fuels Facilities

The Virginia Economic Development Partnership, Department of Agriculture and Consumer Services, and Department of Mines, Minerals and Energy have been working together with prospects interested in locating large-scale production plants in Virginia. As of May 2007, no plans had been finalized.

In 2006, Virginia legislation established a Biofuels Production Fund and Grant Incentive Program to provide a 10-cent-per-gallon incentive for locating a plant in Virginia.

4.8.3 Opportunities and Challenges

In 2006, Virginia legislation established a Biofuels Production Fund and Grant Incentive Program to provide a 10-cent-per-gallon incentive for locating a plant in Virginia. Large-scale plants are now being developed in the 100-million-gallon-per-year or larger range. Virginia may need to consider incentives to spur initial capital investment in these large plants, such as loan guarantees or tax credits to secure investment. Another option would be to give assurance that a plant would receive a guaranteed benefit from the Biofuels Grant.

Virginia needs to expand its retail alternate fuel infrastructure if there are to be significant new uses of the fuels. The Virginia E85 Fueling Infrastructure Project is establishing three sites for government-owned vehicles to refuel. The project also will support development of twelve to fifteen retail locations on the I-95 and I-64 corridors. These efforts help drive market transition and provide justification for large-scale biofuel production in the state.

University-level research is continually advancing in the areas of alternative energy and fuels. Bioengineering of future energy crops and improvement of feedstock-to-fuel conversion technologies are examples. Momentum is building in developing demonstrations and pilot plants. Switchgrass and barley are examples of potential energy crops and represent an area of opportunity for Virginia farmers. Some of the stakeholders in current efforts include the Tobacco Commission, the Institute for Advanced Learning and Research in Danville, state universities, farm owners, and private industry. Virginia should expand and empower partnerships that demonstrate the potential of alternative fuel advancements with an eye to commercial-scale production.

The U.S. Department of Energy is developing rules for a clean energy loan guarantee program authorized in the Energy Policy Act of 2005. The program is intended to spur investment in projects that employ new, clean-energy technologies. A primary program focus is alternative liquid fuels projects. Projects will help sustain economic growth, yield environmental benefits, and allow for a more stable and secure energy supply. Congress provided the Department of Energy with authority to issue guarantees for up to $4 billion in loans. Virginia should promote and use this tool and devise strategies to capture its share of the offering.

Several emerging technologies involve gasification of feedstock. In this process, coal, waste, or wood/biomass residue is converted to gas and the gas then converted to liquid. A major advantage of gasification systems is that the gases they produce contain less particulate matter. It is easier to remove or capture harmful materials such as sulfur and carbon dioxide during gasification processes. However, capital costs can be significantly higher than for conventional combustion systems.

The Department of Defense uses more aviation fuel than any other type of energy. It also uses a substantial amount of liquid fuels for ground and water transportation. Virginia government, research institutions, and industry have an opportunity to work with the Defense Department to help supply fuel-replacement needs. Virginia

Virginia has unique attributes within the nuclear industry that provide an opportunity for it to be the leader in nuclear energy.

should first focus on ground- and water-transportation fuel, then aviation.

Local governments that operate landfills should consider dedicating a portion of their tipping fees to support projects that convert waste to energy and which, in turn, extend the life of landfills.

One of the biggest barriers to landing an alternate fuel project has been finding an appropriate site. State and local governments could consider pre-packaging alternative fuel production plant sites with required zoning and infrastructure (e.g., energy, rail or barge, and water). This could be done in conjunction with demonstrating and commercializing emerging technologies. (See Chapter 6 for a description of developing state-supported, technology-centric sites that offer common, basic infrastructure such as shell space, bulk transport, energy, water/wastewater, by-product/waste handling, clean rooms, etc.)

While there is considerable speculation around the timing of hydrogen technologies, the potential of hydrogen should not be overlooked. Hydrogen could become the prime mover for future automotive and other transportation applications. As provided for in Virginia's hydrogen blueprint, the state should support developing fueling infrastructure as the market develops for hydrogen fuel use.

4.9 Uranium/Nuclear Energy

Virginia has unique attributes within the nuclear industry that provide an opportunity for it to be the leader in nuclear energy. They include the following:

- Energy companies could be as close as a year away from deciding to build the first new nuclear reactors in the United States since the 1970s. Dominion could be one of the earliest, given its consideration of new reactors at its North Anna plant.
- As discussed in Chapter 2, Virginia has a uranium oxide resource in Pittsylvania County that presents options for a uranium mining industry.
- The Lynchburg region is home to BWXT and Areva NP, which design, service, and build nuclear components for the civil and military markets.
- There is a significant Navy presence in Tidewater, and Northrop Grumman Newport News is a primary contractor in the building and servicing of U.S. Navy nuclear vessels.
- Virginia institutions of higher education and their research and development capacity provide an excellent support mechanism that can provide both technical assistance and future workforce training.

4.9.1 Existing Infrastructure

Resources exist to support a uranium mining industry in Virginia (see Chapter 2). Dominion operates two nuclear plants in Virginia, one in Louisa County and one in Surry County (see Section 4.1.1, Existing Generating Infrastructure, above).

4.9.2 Planned Nuclear Facilities

Dominion has asked the Nuclear Regulatory Commission to approve a site for new nuclear reactors at its North Anna Power Station. The company expects to receive a permit for the site late in 2007 and is considering applying for a license to build and operate a third reactor at the plant. Only after a permit is approved, expected around 2010, will it decide whether to build the reactor. However, the company placed early orders for critical nuclear plant components to ensure their availability should the project go ahead.

4.9.3 Opportunities and Challenges-Developing Virginia's Nuclear Cluster

New Reactors

In 2007 Virginia electric utility restructuring legislation provided incentives for new nuclear generation by providing for an enhanced rate of return-twice that of a conventional generating plant and equal to that of renewable energy sources or plants that incorporate carbon capture and clean-coal technologies. The advantages of nuclear generators are that,

Virginia needs to develop strategies that combine the strengths of its university system, in both research assistance and future workforce training, with the needs of its industry partners.

A future opportunity for Virginia is the forthcoming decommissioning of nuclear navy ships. Virginia's unique infrastructure in building these vessels and the major navy presence offer a distinct advantage. Virginia should assist the industry in pursuing and capturing business opportunities associated with nuclear decommissioning.

once built, the facilities operate steady-state at near capacity for decades and provide electricity with near-zero air emissions.

The National Energy Policy Act of 2005 promised financial incentives to companies that propose new reactors. Regulators expect to receive about twenty applications for new plants in the next three years, with at least thirty new reactors. Dominion plans to make its decision on proceeding with the North Anna plant in time to be eligible for the federal incentives. If Dominion decides to proceed with this reactor construction, then there will be opportunities for Virginia businesses to support this construction. Any plant would not likely be completed during the term of this Plan.

Virginia-based Nuclear Energy Businesses

The Lynchburg region is home to BWXT and Areva NP, international nuclear energy firms with significant potential for expansion. Areva specializes in providing equipment and supplies to the energy industry. The company is committed to making sustainable development the focal point of its industrial market business strategy. Areva's manufacturing facility in Lynchburg manufactures process control instruments, inorganic chemicals, measurement and control devices, and pumps and pumping equipment. According to Areva, it had 230 job openings during the first quarter of 2007 and expected a need for 800 jobs over the next five years, with 400 of those being in Lynchburg. If Virginia can help solve the labor problem, Virginia will be the clear number-one expansion target, as no other state is addressing this issue. Virginia needs to develop strategies that combine the strengths of its university system, in both research assistance and future work-force training, with the needs of its industry partners.

If BWXT were to expand in the commercial nuclear market, the Lynchburg area would be an attractive location. Such a move would increase the pool of talented workers within the sector. Increased expertise in the region, along with expanded training programs, could encourage ancillary companies to move to Virginia. Benefits to the sector and to Virginia would include increased customer/supplier relationships, further diversification of the sectors, enhanced training programs, and increased revenue streams for the state and the localities.

Virginia's Uranium Resources

There are sufficient resources to support a uranium mining industry in Pittsylvania County with enough to meet the fuel needs of Virginia's current generation (see Chapter 2). Significant work to assess the risk from mining and need for regulatory controls must be completed before any decision can be made whether such mining should take place.

Navy Presence and Northrop Grumman Newport News

Northrop Grumman Newport News designs, builds, overhauls, and repairs a wide variety of ships for the U.S. Navy and commercial customers. Northrop Grumman is currently the nation's sole designer, builder, and refueler of nuclear-powered aircraft carriers and one of only two companies capable of designing and building nuclear-powered submarines. The largest industrial employer in Virginia, the Northrop Grumman Newport News shipyard is located on more than 550 acres along the James River in Newport News and employs about 19,000 people. The shipyard is home to the Western Hemisphere's largest dry dock and crane. Northrop Grumman is the largest non-governmental provider of fleet maintenance services to the Navy. It also provides after-market services for a wide array of navy vessels.

A future opportunity for Virginia is the forthcoming decommissioning of nuclear navy ships. Virginia's unique infrastructure in building these vessels and the major navy presence offer a distinct advantage. Virginia should assist the industry in pursuing and capturing business opportunities associated with nuclear decommissioning.